2

ON THE TERMINOLOGY AND CLASSIFICATION OF SHORE PLATFORMS

By J. T. Jutson, D.Sc., LL.B.

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Abstract

The present terminology of the two main shore platforms (the high-level horizontal one or group and the low-level sloping one) is considered and criticized as incorrect or inadequate. A new terminology and classification of the various forms of the platforms as at present known are suggested for consideration and discussion.

Contents

Historical

For some years past considerable attention has been paid to the form and origin of the rock platforms which almost everywhere occur at the junction of sea and land. Two types are recognized, one being the low-level platform, which, sloping seaward, extends far out from the land; and the other being the narrow, horizontal or sub-horizontal high-level platform which is usually exposed at low tide, and which, at its seaward edge, passes, in some places abruptly, but in others gently downwards, into the first-named platform.

N. M. Fenneman (1902) used the term 'normal profile of equilibrium' for the combined low-level platform and the sediments deposited upon its outer portion.

Bartrum (1926) accepted the lower platform as the 'normal' one in deference to what he considered Fenneman's priority. In that paper Bartrum referred to the upper platform as an 'abnormal' platform in contradistinction to 'normal,' but he made it clear that it was the normal product of shore-line erosion. Certain types of the upper platform were described by Bartrum as 'storm-wave' platforms, which term was apparently introduced by him.

The writer (1931), in a brief description of some of the platforms in and adjacent to Port Phillip Bay, Victoria (being the first Victorian shore platforms

described so far as known), referred to the upper and lower platforms as the high-level and low-level platforms respectively.

Later the writer, in the course of recording his field observations, began to term the upper platform the 'normal' platform, it being so widespread, inadvertently overlooking (although previously aware of) Fenneman and Bartrum's earlier use of the term 'normal.' The lower platform the writer (1939) termed the 'ultimate' platform. In his Mt. Martha paper (1940), he divided the ultimate platform into primary and secondary ones, according to whether the lower platform was or was not formed without the intervention of the upper one.

Bartrum in a later paper (1935) again used the term 'storm-wave platform' for those platforms included in the upper horizontal or sub-horizontal group which he found at varying heights above ordinary high-tide level, and which were composed of certain classes of rocks of what may be termed a non-structural character (that is, in the main, not possessing bedding planes at or close to the horizontal). Bartrum's storm-wave type would not apply to any platforms cut below ordinary high-tide level, and his 'Old Hat' type would not apply to those platforms at a similar level which could be shown to be the result of cliff-cutting by marine abrasion.

Douglas Johnson (1931), in a discussion as to the origin of Bartrum's storm-wave platforms, did not use that term but included them in his 'two-metre benches.' He explained that such benches normally had their inner margins from a few centimetres up to two metres or more above the level of ordinary high tides, being careful to point out that the exact level varied with conditions of exposure to storm waves, tidal range, breadth of platform and other local conditions, and that the cutting was effective in unweathered rock. He concluded that the true two-metre bench was a normal feature of the present shore.

E. S. Hills (1940) showed that a platform of the upper type at Ricketts Point, Port Phillip Bay, Victoria, had developed along the upper surface of a resistant sedimentary bed, thus recognizing the importance of geological structure in the formation of platforms.

Edwards (1941) applied the term 'storm-wave platform' to all more or less horizontal platforms (other apparently than Bartrum's 'Old-Hat' type) that were distinct from the lower platform, which he termed (following Bartrum and, to some extent, Fenneman) the normal platform. He objected to the writer's use of 'normal' for the upper platform on various grounds with which the writer does not agree, but which need not be discussed here, since the writer proposes, apart from Edwards' criticism, to abandon the use of 'normal' for both classes of platforms.

C. A. Cotton (1942) describes a platform akin to Bartrum's storm-wave one, without giving it a definite name, merely referring to it as a high-water platform, but pointing out that such a platform is so commonly present on shores exposed to heavy surf that it must be regarded as a normal feature, developed by cliff-making processes.

The writer, in a paper on the shore platforms of Flinders, Vic. (these *Proc.*, Vol. 60), recognized that 'normal' and 'ultimate' were not the most suitable terms but that, in the absence of better ones, they were retained for the time being. He suggested that the terms 'upper horizontal platform' and 'lower sloping platform' in replacement of 'normal platform' and 'ultimate platform' respectively were more suitable from the descriptive aspect, but he considered that they were clumsy and were therefore rejected. Similar terminology was used by him in papers on the shore platforms of Lorne, Victoria (1949a) and Point Lonsdale, Victoria (1949b).

Objections to the Terminology Hitherto in Use

(1) Normal Platform. As a designation for either the high-level horizontal or the low-level sloping platform it is correct, because in the writer's opinion both platforms are normal products of marine erosion, notwithstanding that one (the sloping one) is practically attached to every coast and permanent so long as there is no change of sea-level, whilst the other (the horizontal one) is not universal, needing as it does certain special conditions for its production and maintenance. If, however, it is desired to distinguish by name the two platforms, then 'normal' for one alone is unappropriate.

(2) Ultimate Platform. There are two possible objections to the use of this term for the sloping platform. (a) 'Ultimate' implies that that platform has always developed from an earlier platform, but this is not always, or perhaps even commonly, the case. Strictly speaking, it applies only to the writer's secondary type of the sloping platform. (b) It may be taken to mean by some observers that it is the platform's final form and that it suffers no further change, which was certainly not the writer's view when he first used the term, nor is it now. Whilst sea-level remained constant, those parts of the platform which were not covered by marine deposits would be lowered so long as the sea was capable of eroding it. Subject to that qualification, however, its form would remain substantially the same, and it would have no successor. Hence this second objection has really no validity, but at the same time it is wise to remove any possible misunderstanding by changing the term, especially if one more expressive of the nature of the platform can be obtained.

(3) Two-metre Bench. Douglas Johnson applies this term only to benches above ordinary high-water mark. It therefore does not include horizontal benches formed below that mark and hence must be excluded as a term applicable to all benches of the horizontal type.

(4) High-water Platform. C. A. Cotton's name is not sufficiently explicit. It does not state the nature of the platform (horizontal or sloping) or its relation to high-tide level.

(5) Storm-wave Platform. The limitations with which Bartrum uses this term have been noted under 'Historical.'

The type of platform produced by storm-waves alone could doubtless also be cut when the spring tides are very high, or when there is a heavy groundswell and there are no storm-waves present, in either of which events it would be difficult to determine the origin of the platform. Moreover, storm-waves are probably the greatest factor in the formation of almost all types of the horizontal platform. Hence the term 'storm-wave platform,' as defined by Bartrum, should be relegated to a comparatively minor place in the classification.

Edwards appears to consider all the horizontal group (except of course the water-levelling and solution platforms of Wentworth referred to below) as formed by storm-waves, which differs from Bartrum's definition, and which, as used by Edwards, is an unsuitable term, in view of the fact that platforms of the class mentioned can be cut by waves which are not storm-waves.

(6) Lower Sloping Platform and Upper Horizontal Platform. These terms, as already stated, were rejected by the writer.

(7) Low-level Sloping Platform and High-level Horizontal Platform. These terms have suggested themselves to the writer, but they are cumbrous and, furthermore, he finds that the terms 'low-level' and 'high-level' are required for some of the subdivisions of the upper platform.

Classification of Platforms

From the foregoing it seems to the writer that a new terminology, involving a classification of platforms, is required. He regards the fundamental distinction to be between the horizontal platform and the sloping platform. Where both occur together, the horizontal platform is always above the sloping one.

The latter is always present, which is not true of the former. The sloping platform is also of vast extent compared with the horizontal one. The writer has therefore decided to use the terms 'major' and 'minor' to describe the respective platforms. These are not altogether satisfactory, but they do indicate, to some extent at least, the profound difference between the two types. They can, of course, be broken up as desired.

There is little known yet about the major platform, but a growing body of information is available as regards the minor platforms, the reason being, of course, their availability for examination.

The table below is submitted as a provisional one for consideration and discussion. It will probably require much modification as new facts and ideas are brought forward regarding shore platforms.

Classification

1. The Major Platform
   - (i) Primary.
   - (ii) Secondary.
2. The Minor Platforms
   - (i) 'Old-Hat' type.
   - (ii) Wave-erosion types.
   - (iii) Spray-erosion types.
   - (iv) Water-levelling type.
   - (v) Solution type.

Appended are some details of these various types.

1. THE MAJOR PLATFORM

This is the platform shown for many years past in practically all geological text-books as the only platform abutting sea-cliffs. Its characteristic feature of sloping downwards gradually from the cliffs for an indefinite distance is well known. Where, however, a minor platform is present, the major platform commences from the seaward edge of the minor platform.

Most major platforms would not be controlled structurally because, even though they were composed of bedded rocks, their dip would have to coincide with the angle of slope of the platform, which would probably rarely occur. Thus the bedded rocks would generally be truncated, and consequently the platform would not coincide with a structural plane.

The writer (1940) has made a primary and a secondary division of the major platform.

(i) Primary Platform. The characteristic of this type is the absence of a minor platform between the shore and the landward edge of the major platform (Fig. 1). Of course, it is difficult to say that, although the former does not now exist, it has never existed. It may have been destroyed, owing to the more rapid retreat of its seaward edge than its landward advance. Thus, what may appear to be a primary platform is really, in places, a secondary one with the evidence of its origin removed. Where, however, from the nature of the rocks, the possibility of the former existence of a minor platform is remote, the major platform may, until evidence to the contrary is obtained, be regarded as primary.

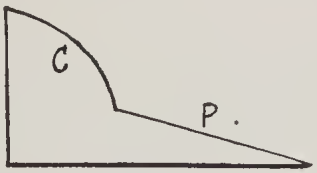

Fig. 1.—Diagrammatic section of a primary major platform.
P. Platform. C. Cliff.

In some instances a minor platform may be seen developing side by side (but each abutting the shore-line) with the major platform, this being due to the occurrence of different classes of rocks favouring one or the other type, as at Mt. Martha, Port Phillip Bay, Victoria (Jutson, 1940), where the minor platform is formed of decomposed granodiorite, whilst the major platform is of a fresh portion of the same rock.

(ii) Secondary Platform. This platform follows a minor platform as the seaward edge of the latter retreats. In that case it is, at least where it abuts that edge, of secondary origin.

2. THE MINOR PLATFORMS

(i) 'Old-Hat' Type. This is the form described by Bartrum (1926 and earlier paper therein cited). It is formed in a comparatively quiet sea from a rock which readily suffers atmospheric decomposition. The rocks weather down to the level of permanent saturation, which is a little below mean high-water level, and the waste products are removed by the weak waves of the sea. The present writer has not observed similar forms, nor does he know of any.

(ii) Wave-Erosion Types. These are formed at varying heights above low-water mark by direct abrasion of the sea. (They may subsequently be modified by sub-aerial action.) They include the 'abnormal' or storm-wave platforms of Bartrum, with the limitation previously noted, the two upper platforms of Jardine (1925), the 'normal' platforms of the writer, the two-metre bench of Douglas Johnson, and, apparently, the storm-wave platforms of Edwards.

Two aspects of these platforms may be considered. First, the occurrence, on some shores, of two or more platforms rising one above another; and secondly, the influence of geological structure on the formation, shape, and extension or reduction of the platforms.

(a) *Two or more Platforms at Different Levels.* These rise one above another at varying heights in relation to mean sea-level or other adopted datum, the difference in height between the different platforms ranging from about one foot

to three feet or more according to the height at which the waves can cut under the then prevailing conditions on any given shore (Fig. 2). They may be formed simultaneously or, where the land has emerged from the sea, successively at fixed intervals. Where only two occur, they may be termed 'high-level' and 'low-level,' as the writer has done in his papers on the shore platforms of Flinders and Lorne, Victoria. (These *Proceedings*, Vol. 60, 61.) Where three platforms occur, they could be termed 'low- (or first) level,' 'mid- (or second) level,' and 'high- (or third) level,' and where there are more than three, other appropriate terms must be used, such as 'shelf' or 'ledge,' which terms the writer has applied to the narrow,

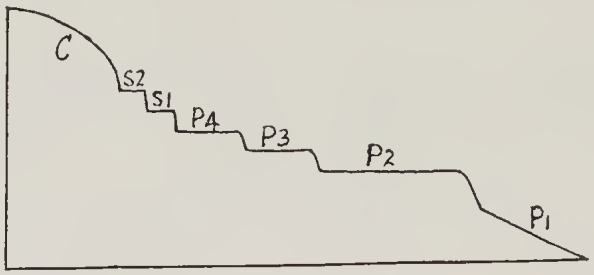

FIG. 2.—Diagrammatic section showing the various possible platforms and shelves. P1. Secondary major platform. P2. Low-level, first-level or basal minor platform. P3. Mid-level or second-level minor platform. P4. High-level or third-level minor platform. S1. and S2. Shelves. C. Cliff.

largely continuous horizontal projections from the cliffs at Flinders and Sydney (Jutson, 1939), where they were above two minor platforms. For similar features Edwards (1941) has used the term 'storm ledges.'

When the platforms are being cut simultaneously the lowest one is the main one, being usually much wider, longer and more continuous than that of those above it. This feature is well shown at Flinders, where, above a wide largely continuous platform, small isolated platforms occur. An alternative appropriate name for the main platform to 'low- (or first) level,' whether it occurs with or without another or other platforms above it, is 'basal.'

Some of the higher platforms are produced partly by the waves and partly by sea spray, a fact which has been noted by Edwards (1941) at Port Campbell and San Remo, both in Victoria.

(b) *Influence of Geological Structure.* The platforms may be separated into structural and non-structural ones, which is a useful division, since the rate of formation or destruction of a platform may be profoundly influenced by the geological structure of the rocks of which it is composed or out of which it has been carved. Similarly the smoothness or roughness of the surface of the platform may be influenced by geological structure.

Structural Platforms: A structural platform is one the surface of which corresponds with a structural division plane, and since the surfaces of the platforms are horizontal or sub-horizontal, that plane must be in the same position. Examples are, of course, horizontal or nearly horizontal sedimentary beds, or approximately horizontal alternating beds of lava flows and pyroclastic rocks.

The division planes facilitate the comparatively rapid removal of the rocks, and this would be intensified if, at about the level the platform was being cut, a bed of soft rock, e.g. shale, overlay a hard rock, e.g. sandstone. The shale would be

rapidly removed along the upper surface of the sandstone bed and that surface would become the shore platform. For examples, see Jutson (1939), p. 244; Edwards (1941), p. 235; and Hills (1940), p. 84. Moreover, according to the vertical position of the hard bed, the height of the platform would vary within certain limits.

A strong system of more or less horizontal joints in an igneous rock would help towards the formation of a structural platform, but it is doubtful whether the joints would be of sufficient regularity and vertical spacing to permit the production of a platform of any evenness of surface. The surface would indeed most probably be extremely irregular. A platform of that description would be intermediate in character between the typical structural and the typical non-structural platform.

Non-structural Platforms: Non-structural platforms may be divided into two classes—(a) sedimentary rocks, and pyroclastic rocks alternating with lava flows, all with a definite dip; and (b) massive igneous rocks, e.g., granites and basalts. In the first group the platform truncates the beds and in most instances would have a fairly even surface, although the harder beds would tend to project above the general surface. In the second group, owing to the prevalence of strong joints, the surface would be irregular, especially in the case of basalts with strongly marked columnar structure.

(iii) Spray-Erosion Type. Ongley (1940) has shown that the spray of waves is eroding, by differential weathering, platforms 55 feet to 80 feet above the sea. 'The beds fronting the sea strike parallel to the coast and dip inland.'

Bartrum in a personal communication to the writer states that he has seen a structural platform quite 100 feet above sea-level being eroded by spray, the beds removed from the bench being soft sandstones.

As noted by the writer (1939) near Sydney, spray alone is probably forming platforms (ledges or shelves) by the removal of shales which alternate with sandstones, the upper surface of the sandstones forming the tops of the ledges or shelves (p. 246).

All these examples illustrate structural control in the formation of the platforms.

It is difficult to conceive of spray-eroded platforms of a non-structural type, but it is interesting to note that Wentworth (1938) states that spray-erosion may have moved a large block of rock. Thus there is the possibility of a very irregular platform being formed of the non-structural type, but perhaps its surface would be so irregular as hardly to deserve the name of 'platform.'

All spray-erosion platforms are doubtless modified in a greater or less degree by atmospheric erosion.

(iv) Water-Levelling Type. This has been fully and first described by Wentworth (1938). Shortly stated, the mode of formation appears to be that on a pre-existing platform the surface is such that pools of water can collect, and that those parts of the platform which rise above the pools weather away owing to alternate wetting and drying, with the result that the surface tends to become more level. Wentworth considers that water-levelling can take place simultaneously at different levels. If that be so, and the levels are fairly well defined over comparatively large areas, then the terminology suggested for the wave-erosion types of the minor platform may be suitable.

(v) Solution Type. Wentworth (1939) has also shown that there are platforms in limestone which have been formed by the solution, chiefly by fresh water, of the limestone surface. Until more examples are known, no subdivision of this type will be attempted.

3. RAISED AND SUNKEN PLATFORMS

An objection may be offered to the classification above proposed on the ground that it takes no account of raised or sunken platforms. Platforms may of course be raised or sunk either tectonically, or by a eustatic fall or rise, as the case may be, of sea-level; and so they can be divided into raised, sunken, non-raised and non-sunken platforms. (The last two terms are used to avoid using the word 'stationary,' which would be misleading.)

Whether or not there has been a change in sea-level and so altered the relative positions of the platforms, the fundamental division into the major platforms and the minor ones remains. If there has been emergence or submergence, then the result of that action can be added as a qualifying term to the fundamental name, as, e.g., a raised minor platform.

Other distinctions will be necessary. Thus a raised major platform may become by erosion, in part, a minor platform. Similarly, a minor platform on submergence may by erosion become part of the major platform. In cases like these the required qualifying terms must be found.

Acknowledgment

The writer desires to place on record his great indebtedness to Professor J. A. Bartrum, of Auckland University College, Auckland, N.Z., who has been one of the pioneers in the modern study of shore platforms, for many valuable suggestions and for helpful criticism in connection with the subject matter of this paper.

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